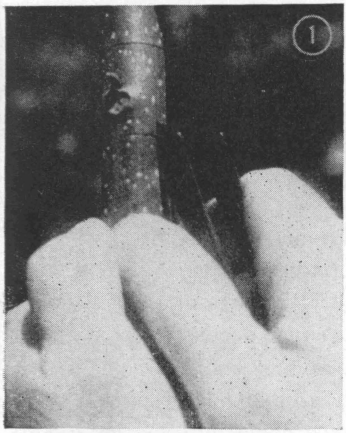
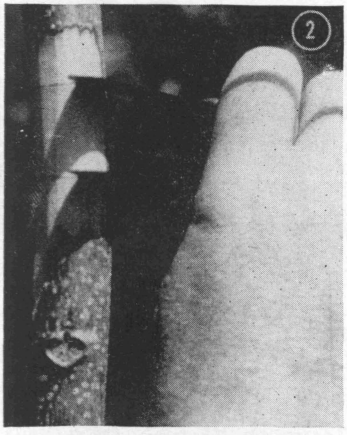
B-166 1949

PROPAGATION OF PECANS by Budding and Grafting





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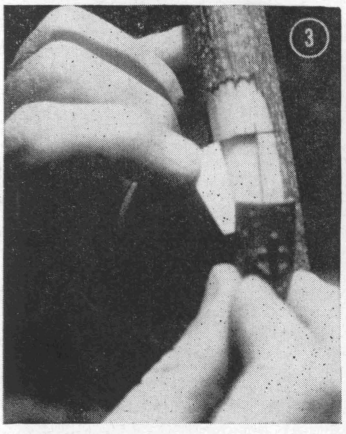

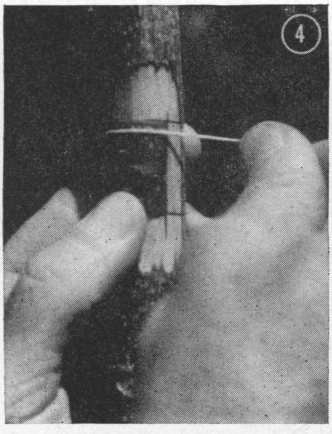

Introduction

The purpose of this bulletin is to provide practical information which may be applied to change undesirable native pecan trees to improved varieties.

Pecan production in Texas is primarily native or seedling pecans. There are millions of pecan trees of this type along the creeks and rivers throughout the south, central and western parts of the state. Some native pecan trees produce pecans of good quality. Many such trees are profitable as they stand and should not be budded or grafted. Small trees that have not yet come into bearing or even those that have come into production but produce inferior nuts are good subjects on which the budding and grafting program can be used.

It is important that a very careful study of varieties be made before an attempt to bud or graft native trees is made. Only varieties of proven adaptation should be used on a large scale.

Varieties recommended for the various sections of the state are listed in Extension Service Bulletin B-162, which is available through the Texas A. & M. College Extension Service, College Station, Texas.

On the cover: 1) Cutting bud from bud stick; 2) preparing bud stock for placement of bud; 3) peeling bark to expose cambium for bud placement; 4) tying the bud in place, and 5) covering with wax cloth and tying with cotton string.

PROPAGATION OF PECANS BY BUDDING AND GRAFTING

By

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with

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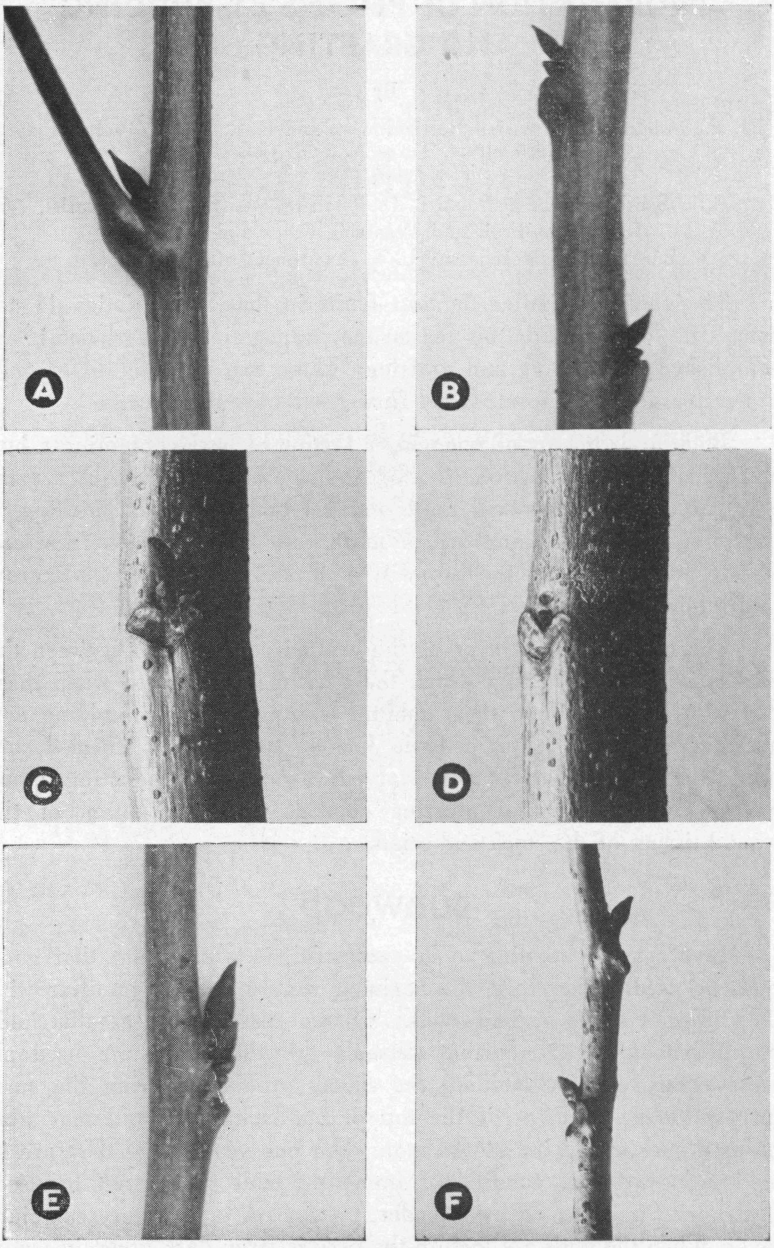
The pecan is similar to most fruits in that the varieties do not come true to seed. For this reason the propagation of varieties is accomplished by budding and grafting. These two methods differ only in the operations performed; the final results are the same.

Budding is the art of removing a section of bark containing a bud and transferring it from one tree or branch to another in such a manner that the two parts will unite and the bud grow. In grafting, a part of a shoot containing one or more buds is transferred from one tree to another so that the two will unite and the bud or buds grow into a new top.

The cambium is a layer of thin-walled cells located between the bark and the wood, along which the bark may be peeled when these cells are active. When the cambium is injured, as in budding and grafting, a spongy wound tissue known as callus is formed and unites the separated parts to reestablish normal sap-conducting tissue. Success in all forms of grafting depends upon the union of the wound tissues of the stock and scion.

BUDWOOD

In order for budding to be successful, it is necessary that good buds be used. Therefore, the beginner should become familiar with the different kinds of budwoods. Current-season buds are the buds on the shoots of the current season's growth. These are used almost exclusively for budding the shoots produced during the summer following removal of the top of cut-back trees, and may also be used successfully on stocks more than one year old if they are in a vigorous growing condition. Immature buds should not be used. Immaturity is indicated by a tender, green bark or a watery cambium layer. When the buds are mature the bark is firm, dark green in color, and the wood in the growth is hard. In no case should the budwood be more vegetative, or sappy, than the stock to be budded.



Some types of buds. A, Current-season bud; B, current-season bud with leaf petiole cut down for budding; C, a plump, well-developed bud that will force easily; D, bud too small to force readily; E, a poor bud, wood too gnarled under bark, and F, bud stick too small for ordinary use.

Current-season buds may be used after July 1 and as long thereafter as the bark will slip from the wood. Current-season budwood may be held in cold storage at 32°F to 38°F for three to four weeks. The smoothest and most mature buds are found on the basal end of the bud stick. Discard any immature or knuckled buds on the terminal end. The term "knuckled' refers to a bud situated upon a considerable gnarl in the wood. This causes a pocket underneath the bark when the bud is removed.

When current-season buds are used, the leaf stem is cut down close to the bark. The exposed cut area is covered by the cloth or wax used to seal the bud. If the leaf stems are cut off about one inch above the base about three weeks before the buds are to be used, the stems will drop off.

One-year wood is preferable in all cases where the buds are to be forced immediately after they have united with the stock. If the buds are not forced until the following spring, buds from wood two or three years old are practically as good from the standpoint of forcing as those from one-year-old wood. When buds are to be set on large stocks two to three inches in diameter and forced the following spring, buds from large sticks of two-or three-year-old wood are desirable because it is easier to fit and tie the large bud patches on the larger stocks.

STORAGE AND SEASONING OF BUDWOOD

The best time for cutting storage budwood is during the latter part of the winter, preferably in late February or early March. Budwood cut early in the winter does not season as quickly or as uniformly after removal from storage as that cut just before the sap rises in in the spring. The most desirable budwood is that from vigorous shoots of the previous season's growth. The best budwood is found toward the top of the tree. Shoots ranging from $\frac{3}{8}$ to $\frac{3}{4}$ inch in diameter are desirable for budwood. A pole pruner six to twelve feet in length facilitates the cutting of budwood. The shoots may be cut twelve to eighteen inches in length and tied into small bundles. The larger basal portions of the shoots are desirable for budwood and the smaller terminal growth usually should be discarded. Some of the latter may be suitable for graft wood, but most of it is not sufficiently well developed. Cut graftwood into lengths of six to eight inches.

Tie bundles of budwood tightly near each end so that the sticks will not be loose enough to twist about in handling. As each bundle is tied make a cut of approximately an inch in length into the wood on one of the budsticks and write the name of the variety on it with a lead pencil. After the budwood is cut, tied, and labeled, place it in moist shingle tow, sphagnum moss, peat moss, or equal parts of shavings and sawdust. The material in which the bundles are packed should not be so wet that water can be squeezed out of it but should hold enough moisture to prevent drying out of the budwood in storage. Large cans with good fitting lids are preferable to wooden boxes as containers since they do not permit drying out of the budwood. When budwood is held in cold storage at 32° to 38°F, it remains in a dormant condition until ready for use at any time throughout the growing season. When cold storage is not available, budwood may be kept for several days if packed in moist shavings or peat moss mixed with chunks of ice.

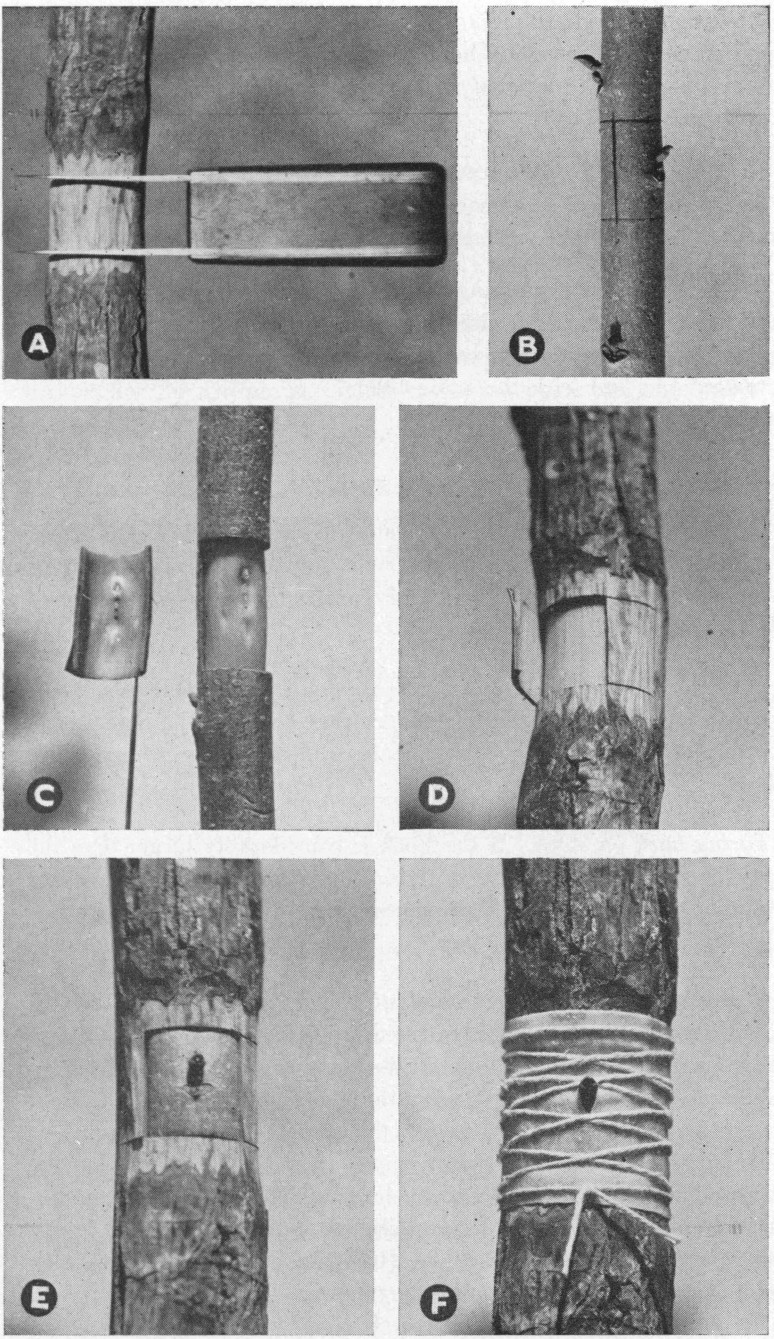
Cut grafting wood at the same time as budwood and store in the same manner.

Budwood from cold storage is dormant and must be seasoned before the bark will peel so that the bud patch can be removed for use. The seasoning is accomplished by packing the budwood in moist moss, wood shavings, or sawdust, and holding it at a temperature of 80° to 85°F. Under these conditions the budwood usually will be ready to use within four or five days, but in early spring it may require a little longer. Use the budwood soon after it is seasoned, or return to cold storage because buds from overseasoned budwood usually give poor results.

THE PATCH METHOD OF BUDDING

The principal budding method used in the propagation of pecans is the patch bud. This consists of peeling a patch of bark about an inch square containing a bud from the bud stick and placing it onto a peeled place of the same dimensions on the stock, tying it down

Successive steps in patch budding. A, make parallel cuts across the stock with budding knife. Follow with a longitudinal cut at right end of parallel cuts. B, make parallel cuts above and below the bud on bud stick with same budding knife, and make longitudinal cuts on each side of the bud. C, remove the bud; D, raise the bark on stock. E, insert bud patch underneath raised bark on stock, fitting it snugly at right side. Tear off bark of stock so that it slightly overlaps bud patch at left side. F, cover the area with a rectangular patch of waxed cloth, allowing bud to protrude through a hole in the cloth, and tie down firmly with strong twine.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firmly so that the cambiums are pressed into contact, and then sealing to prevent drying out. The successive steps in the procedure of patch budding are illustrated on page 7, and the instructions for each step are as follows:

a) Make parallel cuts across the stock with a budding knife or tool having parallel blades spaced about one inch apart; follow by a longitudinal cut near the right end of the parallel cuts.

b) With the same budding tool, make parallel cuts on the bud stick above and below the desired bud and then longitudinally on each side. After each longitudinal cut is made raise the bark a part of the way toward the bud with the knife blade.

c) Remove the patch of bark containing the bud.

d) Raise the severed bark on the stock.

e) Insert the bud patch underneath the raised bark of the stock. The bud patch is fitted snugly at the right side and the raised bark of the stock is torn off so that it slightly overlaps the bark of the bud patch on the left side.

f) Cover the area including the bud patch with a rectangular piece of waxed cloth, allowing the bud to protrude through the hole in the center of the cloth, and tie down firmly with strong twine or rubber band.

Paring bark on stock. If the stock is considerably larger than the bud stick, pare the bark so that it is approximately the same thickness as that of the bud stick. This makes it possible to tie the bud patch firmly against the cambium layer.

Removing the bud from the bud stick. Take the bud from the bud stick without splitting the bark and with as little injury as possible to the cambium underneath. Use the knife blade to push up the bark on each side of the bud without sticking the blade underneath the bark to pry. Grasp the bud firmly between the thumb and first finger. It may usually be lifted off. If it does not respond to this effort, the bark may have to be pried loose by inserting the knife blade underneath it, but great care must be exercised to avoid unnecessary injury to the cambium. Transfer the bud from the bud stick to the stock without delay after the bud has been removed because the cambium cells die quickly upon exposure to the air.

The bud patch is usually cut so as to take a strip of bark not less than half-way around the bud stick, as a higher percentage of the buds will live if the patches are relatively wide.

Tying. For the tying-in of buds, cotton twine of 6-ply or stronger is recommended, or rubber bands may be used. Wraps should not be spaced more than 1/4 inch apart and should pass around the bud, drawing the patch firmly against the cambium of the stock, especially at the point of the leaf scar.

When to remove the strings or bands. Release the strings or rubber bands after the wound of the budding operation has healed, as indicated by the filling in of the cavities around the bud patch with wound tissue. The length of time required for wounds to heal differs according to the activity of the tree and the size of the wound. The strings are usually cut three weeks after budding by drawing a knife blade across the strings at the side of the stock opposite the transplanted bud. On large stocks the strings should remain tied longer than on small stocks, especially if the buds are not to be forced immediately.

Forcing. If the bud patch makes a union with the stock it will appear green when pricked with a knife blade. The bud within the bark patch may then be assumed to be alive and established as a part of the tree. The beginner often thinks the work is now complete, but without the additional procedures of forcing and aftercare of the buds, the work done thus far will prove entirely useless.

To force a bud into growth the stock is cut off above the bud at a distance of three to six inches. Native shoots on the stock are usually the first to grow and should be removed at intervals during the early growth of the bud.

When to force buds. The natural time for new growth to start in the pecan tree is in early spring and every effort should be made to force all transplated buds at this time. The buds are more readily forced into growth then and they make greater growth in the long growing season than buds that are forced later. If the buds and sprouts are removed from the stock in early spring, even very small or old buds that are well imbedded in the bark of the bud patch can be forced into growth, whereas if the forcing is delayed until later in the season the transplanted buds often fail to grow, or may make little growth during the remainder of the season.

When buds are set at the time the bark begins to slip in the spring, but before the leaves appear, the stocks may be cut off at the time of budding. The stored plant food in the stock is sufficient to effect a union of bud and stock and the buds will be forced into growth. If budding is done later in the season, the stock should not be cut off until after the bud has made a union (except as specified for current-season shoots) because the leaf activity in such cases aids in callus formation, counteracts bleeding and helps to retain the vigor of the stock. However, the stock may be cut off to force the buds as soon as the unions have been effected if the tree is still growing vigorously.

Good judgment is often required to decide whether to force buds at the time the strings are cut or to let them remain dormant until the following spring. If the stock is a small tree less than three inches in diameter and the entire top is to be cut back to force the bud, it may be cut back and the bud forced as late as June 1. If a larger tree has been budded on several branches, it is usually better not to force the buds after May 1 because 1) large trees are injured more than small trees by removal of branches and leaves during the growing season; 2) if only a part of the branches are removed the buds are likely to force poorly, or not at all, as the growth is diverted from the stubs to the foliated branches; and 3) if the buds are left dormant and are forced with the beginning of growth the following spring, they will eventually overtake those forced late in the previous season because the tree will be more vigorous as the result of retaining the leaves throughout the previous season.

When the native shoots of cut-back trees are budded with current-season buds in midsummer, the shoots on which the buds are set are usually partly cut back at the time of budding, but no other growth should be removed from the tree. In this procedure relatively little of the entire leaf area of the tree is removed. The cutting back of the stocks prevents the rapid binding of the strings and forces some of the buds into growth.

Aftercare of buds. After the bud has been forced into growth further attention is required in order to develop the growth properly. The shoot growth from the bud must be directed so as to form the desired branch or tree. Native growth must be controlled to prevent it from choking out the new shoot or interfering with its growth or direction. Eventually (one to three years) no growth should remain on the tree except that from the one or more buds used to topwork it. However, except in the case of small trees, the removal of seedling

growth should be brought about gradually as the new top develops. This will be further discussed in another part of this bulletin.

The first rapid growth of the shoot from the bud is inclined to become top-heavy and is easily broken out at the point of union with the stock. Either of two common methods may be used to prevent loss of shoots in this manner. The safest method is to tie the shoot to a substantial stake. For this purpose, use a strip of cloth in tying to prevent injury to the tender shoot. The stake may be a stick tied or nailed to the stock. Plaster laths make suitable stakes, as they are straight, can be nailed to the larger stocks, and are inexpensive. If the shoot is on an upright branch, the stock projecting beyond the point where the bud was set may be used as a stake while the shoot is small. The latter may also be used on small trees or stakes may be driven into the ground beside the tree.

Another method to prevent breaking out of shoots consists in cutting out the tip of the shoot before it becomes top-heavy. This checks growth, and causes branching which is usually desirable.

When to use the patch bud method. Due to the fact that the success of budding depends upon the union of the cambium of the bud patch with that of the stock, it is necessary that budding be done when the cambium is active. Patch budding should not be done during the period of highest cambium activity which occurs when the trees have reached the full leaf stage of growth. The most favorable conditions for successful budding and forcing of stocks of all sizes are found at the time the bark begins to peel in early spring.

When patch buds are set during the period of high cambium activity the sap may ooze into the wound. This is commonly termed bleeding and is said to result in souring or drowning out of the buds, causing their death. The bleeding is aggravated by knife gashes that extend into the wood of the stock but may occur without such cuts. Whether the loss of buds under such conditions is actually due to fermentation of the sap or to an incompatible condition of the cambiums is not known, but it is known that such conditions are unfavorable for budding. At the time buds are susceptible to drowning the cambium appears watery when the bark is lifted. The bleeding is largely avoided if the stock is not cut off until the bud has made a union with the stock. It is probable that more bleeding occurs in small stocks than in large ones.

BUDDING LARGE TREES

The shoots of large trees cut back the previous winter are suitable for budding in the summer after the shoots have become mature. On young trees the bark is thin and a large number of shoots grow out early in the season. These may be sufficiently mature for budding by the middle of July.

On large trees that are cut back to large stubs having thick bark, the shoots may not be ready for budding until August 15 or even later. Cut-back trees are often budded too early. The best success with these trees is obtained by budding them later in the season and forcing the following spring.

THE INLAY BARK GRAFT METHOD

In a study of defective graft union, Sitton found that most of the grafts had united with the stock only at the lower end of the scion. Many were damaged by borers because of excessive callus formation around the graft and underneath the bark. He found that the inlay bark graft gave the best union of stock and scion and resulted in less damage from borers. By this method no cavities are produced under the bark and since there is only a small amount of space between the two cambiums, it is quickly filled with callus to the tip of the stock which promotes rapid healing. Nails hold the scion firmly against the stock and this strengthens the union. After the top of the stub heals over, the scion is very securely anchored and practically safe from breaking out.

The inlay bark graft method is illustrated on page 14, and directions for the successive steps are given below.

In order to prevent splitting and peeling of the bark, remove the upper portion of the branch by making two cuts. In making the preliminary cut, saw from the under side of the stock until danger of splitting has been avoided, then complete the cut from above. The second cut is made six to 12 inches below the first by sawing straight across the stub so as to leave a smooth surface.

Smooth the end of the stock lightly with a knife and then remove the scaly, dry bark at the location selected for setting the scion. If the stock is larger than 2½ inches in diameter a second scion should be set opposite the first; if larger than four inches, a total of three or more scions should be set. The extra scions aid in healing the top of

the stock and also increase the probability that a living graft will be obtained. If the stock is cut just above a small branch or dormant bud, the growth of either of these will serve the purpose of keeping the stock alive and healing the wound. To make the graft, proceed as follows:

a) Cut the scion to a straight bevel two to three inches long on one side. The scion should have two or three good buds which should not be damaged in cutting the scion.

b) Cut the tip end of the bevel square across where it is about 1/8 to 3/16 inch thick, according to the diameter of the scion.

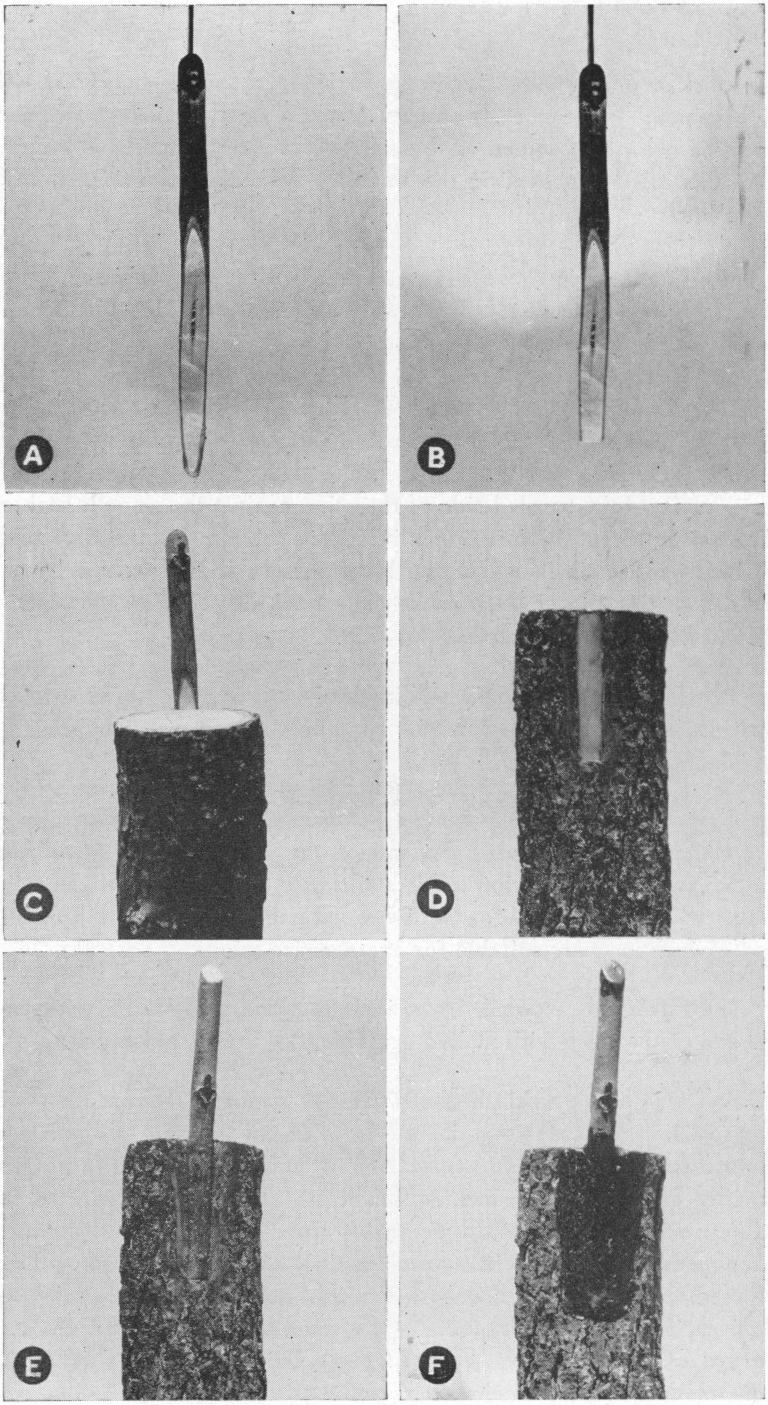
(c) Hold the beveled side of the scion against the smooth bark on the stock in the position in which it is to be set. In this position about 1/2 inch of the apical end of the bevel surface should extend beyond the end of the stock. Inscribe the pattern of the scion on the bark of the stock with a knife blade.

d) Peel down the bark within the inscribed lines so as to make a recess into which the scion will fit snugly.

e) Place the bevel of the scion into the prepared recess so that the back extends over the bottom surface of the scion. Fasten with two nails, one driven near the end of the stock and the other near the lower end of the scion. The nails may be started into the scion before placing it in the slot. Flat-headed nails of gauge No. 18 or 19 and 3/4 inch long are suitable for average size scions.

f) Cover the exposed areas, including the end of the scion and the end of the stock with melted grafting wax or melted paraffin.

Scion Wood. Since the buds are not removed from scion wood, the selection of the wood is not so difficult as that of budwood. Mature shoots of one- or two-year-old wood of relatively large size, ranging from 3/8 to 1/2 inch in diameter, are generally selected for scion wood. These should be taken from vigorous trees. Poorly developed shoots or the immature terminal ends of shoots should not be used. Dormant scion wood from cold storage is used almost exclusively for bark grafting. After the wood has been taken from cold storage, use it before the bark will peel. Scion wood is stored in the same manner as bud wood. See page 6.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Size of stocks. The bark graft is best suited to stocks ranging from 1½ to 3 inches in diameter. Stocks larger than four inches in diameter are objectionable because the wounds are difficult to heal. However, where there is no alternative, stocks considerably larger than four inches in diameter may be grafted provided several scions are set on each stub.

When to graft. Bark grafts may be made at any time when the cambium of the stock is active, but it is usually considered inadvisable to continue grafting later than four to six weeks after the bark can first be peeled in the spring. In the early part of the season, more stored plant food is available to the grafts and they also have a longer growing season than those set later.

When grafts are made under conditions where the cambium is very active and the sap flow is strong, bleeding may result in the same manner as described in budding and this may cause the scions to die. This is especially true if the entire top of the tree is removed.

Aftercare of grafts. One of the distinct advantages in bark grafting lies in the fact that the scion will make its initial growth without the procedure of forcing which is necessary in budding. There is no need of visiting a graft until about three weeks after it has been made. If the operation was successful, the scion will have started growth. Native sprouts will be found on the stock, and none of these should be allowed to crowd the scion or interefere with its proper direction of growth. At the same time, the development of some leaves other than those of the scion should usually be allowed, the number depending upon the amount of growth on limbs not cut away, the size of the tree and the time of the season. As a general rule, if more than half of the top was removed in grafting, ample foliage may be provided by allowing sprouts to grow on the trunk of the tree and on the stocks where they do not interefere with the scions. On small trees it is not necessary to leave many sprouts for this purpose.

The elimination of the native growth should be accomplished

Successive steps in inlay bark grafting. A, Cut the scion to a straight bevel. B, cut the tip end of the bevel straight across where it is about ⅛ or 3/16 inch thick. C, hold bevel firmly against the smooth bark of the stock, allowing about ½ inch of the bevel surface to extend above the end of the stock. Inscribe the pattern of the scion on the bark of the stock with a knife blade. D, remove the bark. E, place the scion in the prepared recess and fasten with two nails, one driven near the end of the stock and the other near the lower end of the scion. F, cover the exposed areas, including the end of the scion and the end of the stock, with melted grafting wax (Grafting wax No. 2, page 25.)

gradually. If the trees are small so that only one to three grafts are used to make the new top, most or all of the native growth may be removed at the end of the first season. In large trees it is usually advisable not to remove all seedling growth until the end of the third season.

After the grafts start growth the resulting shoots may grow so rapidly that they become top-heavy and break out. This may be prevented by tying the shoots to stakes, or the tips of the shoots may be pinched out during the growing season, to prevent excessive growth.

Healing the wounds. A stub that extends an appreciable distance beyond the last growing branch soon dies. For this reason the scion should make a union at the end of the stock on which it is placed. The bark growth of the scion beyond the end of the stock causes the new bark and wood to form over the end of the stock as the scion grows. If the stock is not over 2½ inches in diameter, one graft will heal the wound in due time. If the stock is from 2½ inches to four inches in diameter, it is necessary to provide an additional scion or a seedling branch on the opposite side to keep the stock alive. Do not allow this scion or branch to grow as rapidly as the first and its growth rate can be regulated by cutting it back occasionally. When the wound has healed, saw this scion or branch off flush with the end of healed stub. If a stock larger than four inches in diameter is grafted, use three or more scions. All but one of these should be dwarfed by cutting back and should eventually be removed when the end of the stub has healed, their function having been accomplished.

THE MODIFIED INLAY OR BARK GRAFT METHOD

A modification of the inlay graft is recommended for stocks less than one and one-half inches in diameter because it is difficult to nail the small scions that must be used on such stocks. This form of the bark graft differs from the inlay graft in that the tip of the scion bevel is not removed, but is inserted underneath the bark after being properly trimmed to expose the cambium, and the thick upper part of the beveled scion is fitted into a slot, as in the inlay method. Directions for making modified grafts are as follows:

a) Cut the scion to a long bevel.

b) Hold the bevel of the scion against the smoothed bark of the stock and mark the outline of the upper half on the stock with a knife blade. Remove the bark so as to make a slot that will accommodate the upper half of the bevel of the scion. Make a short incision through the bark at the lower end of the slot and halfway between its sides so as to allow the bark to part as the scion tip is pushed underneath it.

c) On the lower half of the bark side of the bevel of the scion, trim the bark from the edge of the wood so as to expose the cambium at the tip in such a manner that it will contact the cambium of the bark of the stock when the scion is inserted underneath it.

d) Insert the scion in the prepared slot and push the tip underneath the bark along the incision below. On small stocks, extend the scion beyond the end of the stock about two inches, and expose about one-fourth inch of the bevel. On larger stocks the scions should be correspondingly longer and the bevels exposed up to one-half inch.

e) Cover the exposed area, including the top of the stub, with a strip of cloth. Split the cloth at one end and fit the two ends over the end of the stub so as to cover it completely. Seal by applying melted paraffin to the cloth with a brush. The function of the cloth is to prevent cracking of the paraffin. Grafting wax alone will crack on this type of graft.

f) Tie with strong twine.

Aftercare. The aftercare is the same as for inlay grafts except that it is necessary to cut the strings. These should be cut when they have begun to bind. If necessary, tie the shoots to stakes at this time. These grafts break out more easily than inlay grafts, since they are not nailed.

SELECTION OF TREES FOR TOPWORKING

If the grove consists of a mixture of bearing and small trees, it is important that due consideration be given to the selection of trees to topwork. As a rule it is considered much wiser to topwork a tree twelve to twenty-four inches in diameter, if it is suitable for topworking, than to cut it down to make room for a small tree. When the top has been re-established on a tree one foot in diameter, a yield of twenty-five to fifty pounds of nuts should be obtained

as a moderate crop in three to five years, while a tree two feet in diameter should produce more than one hundred pounds under similar conditions. Ordinarily, it requires from ten to twelve years for a two-inch tree growing under sod conditions to attain a diameter of one foot, and twenty-five to thirty years to grow to a diameter of two feet. Therefore, the labor or money spent in topworking the larger trees is usually more profitably invested than that spent in topworking small trees. It is only when a large tree is dangerous to climb, failing in vigor, or has a frame ill-suited to topworking or is too crowded, that its removal to make room for a small tree is justified. Of the bearing trees selected for topworking, low yielding trees or those that bear nuts lacking in quality should be topworked first. Select healthy trees for topworking regardless of their size.

TOPWORKING LARGE CUT-BACK TREES BY BUDDING

In most cases it is impractical to set buds in the large branches of pecan trees. For this reason such trees are headed back and buds set on the shoots that develop on the stubs. This method of topworking is simple and does not conflict with other farm labor at the time the various operations must be performed. It is recommended for general use by growers.

Cutting back the trees. The decision as to where to cut off the branches is important and requires some study of each tree before the operation is started. In most cases, it is desirable to retain as much of the framework of the trees as can be done without difficulty in climbing and without risking the breaking of branches with the consequent danger to the workman. Trees should not be cut back severely in preparation for topworking. The reasons for this are 1) The object of topworking is to obtain a greater income from the tree. The income from the tree will depend upon the size and bearing capacity of the new top as well as the price per pound of the nuts produced. The less severely a tree is cut back, the more quickly the top is rebuilt, and the sooner it will produce profitable crops. 2) A wound of four inches or less in diameter heals readily, while larger wounds may be damaged by wood-rot fungi, which would cause difficulty in healing. 3) A large stub has a thick bark and the shoots that come through it cannot readily push the bark aside. As a result, many new branches become bottle-necked at this point and are easily broken out. The pinching of the sprout by heavy bark also favors entry of woodboring

insects at the base of the shoot. This damage may cause the bud sprout to break off. These difficulties may be largely avoided by removing the thick bark around the base of the budded sprouts with a chisel. This is an expensive and tedious operation. A small stub has a thinner bark and the sprouts are much better anchored. 4) The less severely a tree is headed the more leaf area it will have, and consequently the food reserves of the tree are more nearly maintained so that the vigor of the tree is not greatly disturbed by the topworking process. 5) A tree top may be sawed out in less time and with less labor by cutting where the branches are small. 6) Small branches are easier to remove without splitting the stubs than large ones.

Severe cutting of a large tree merely to save labor in budding is never justified. After the propagator has climbed into the tree it is relatively little more work to set or care for the additional buds required for the tree that is cut back properly. Under ordinary circumstances the value of the tree per additional bud established in topworking is much greater than the cost. The individual who reduces the labor of budding by cutting back his trees too severely will likely find that he has reduced the yield of nuts in much greater proportion than the saving of labor.

In cutting back a tree for topworking, the point at which the branches are cut off can be determined after climbing into the tree. However, a study of the tree from several angles before climbing it often aids the workman in his decisions. Remove the lower branches first so that the upper branches may fall without obstruction. To avoid splitting the stubs, a branch should first be sawed from the lower side until the saw begins to bind and then finished from the upper side. The convenience with which the resulting stub may be reached for budding and pruning should be considered before making any cut. A location that is easy to reach with the saw may be inaccessible to the propagator, since he must get close to the end of the stub.

Cut back all branches in the upper part of the tree, but near the lower part of the tree small branches that are not to be budded may be left to supply additional leaves.

Protect cuts larger than two or three inches in diameter with a coat of preservative paint or wound dressing made of equal parts of asphalt paint and carbolineum. In Western and Central Texas, small cuts do not require this protective coat, since experience has shown that such cuts heal satisfactorily without such treatment.

However, in regions of high rainfall all wounds should be protected.

Trees may be cut back at any time during the dormant season. After the sap begins to rise in the spring, bleeding will occur where the cuts are made. This may not greatly harm the tree, but it should be avoided where possible.

Treatment of sprouts. After the tops have been cut back, the propagator will profit by giving some attention to the developing sprouts. If a large number of sprouts are produced on a stub, none of them may grow to a size suitable for budding in the summer. In such cases thin the sprouts when they are about one foot long, leaving four to eight per stub, according to the size of the stub. Thin only the sprouts from one to two feet back from the ends of the stubs. Remove the heavy bark at the base of sprouts that are being pinched with a chisel or heavy knife. The sprouts on the trunk of the tree should not be disturbed at this time.

When to bud cut-back trees. The proper time for budding cut-back trees is during the first summer after the vigorous growth of the new shoots has subsided. Sprouts from small stubs start growth early and may be mature enough to bud by July 15, whereas sprouts from large stubs start growth later, owing to the thick bark of the stub, and are usually not mature enough to bud before August. Every effort should be made to bud trees during the first summer after they are cut back, since this is the quickest and easiest way to re-establish the bearing tops. If budding is delayed until the following spring, every effort should be made to set the buds at the earliest budding date.

Budding the trees. Current-season buds put on by the patch-bud method are generally considered most satisfactory for mid and late summer budding. Buds from cold storage may also be used successfully. Set one bud about eight inches from the base of each shoot. If the tree is still growing at a moderate rate as indicated by the slipping of the bark on the small shoots, cut each budded shoot off at such a distance that four leaves remain above the bud. The buds in the axils of these leaves should also be cut out at this time. The object of these procedures is to force a large percentage of the transplanted buds into growth and to prevent the strings from binding too soon.

If the tree is no longer growing vigorously at the time of budding, as will be indicated by a checking of the terminal growth, it is better

not to cut off the budded shoots and delay forcing the buds until the following spring.

In budding cut-back trees a sufficient number of shoots should be budded to insure the necessary branches for the new tops. It is unusual for all buds to live and there is usually some loss of buds that start growth. If all the buds grow they may be thinned, if necessary. Ordinarily from two to four shoots per stub should be budded, depending on the size of the stub. This will usually insure enough branches for the new top. It will eliminate the labor of rebudding the tree and the top will develop more uniformly.

Aftercare of the budded tree. During the first winter after the tree is budded all shoots other than those with transplanted buds or shoots that may be needed for rebudding should be cut to stubs about three inches long. Shoots on which the transplanted buds were forced out the previous summer should be cut off about two inches above the buds, and shoots on which the transplanted buds are dormant should be cut off two to three inches above the buds. All seedling buds on the budded shoots should be rubbed off. This will force the transplanted buds into growth in the spring.

Shortly after the buds have opened in the spring, or when the shoots are about one inch long, it is again necessary to remove all seedling growth from the budded shoots. Repeat this operation at ten-day intervals until all transplanted buds have produced shoots at least three inches long. No seedling sprouts should be removed from the trunk of the tree during the spring or summer as these produce leaves necessary to keep the tree in good condition. If the shoots grow rapidly, it may be necessary to pinch out the tips when the shoots are about ten inches long to prevent breakage by winds. This will also cause the shoots to branch, which is desirable in forming a compact new top in the tree.

During the second winter, cut back all seedling sprouts to short stubs. At the same time all necessary pruning of bud growth should be done. Buds that have made a single long shoot should be cut back to cause desirable branching, thus preventing them from becoming top-heavy. Correct bad forks by proper pruning.

The tree requires less attention during the second summer. Remove seedling sprouts which tend to crowd the bud. At the end of this year's growth the budded top should be large enough to supply the foliage that the tree needs. Therefore, during the third winter

all seedling branches should be sawed off, flush with the bark of the tree. A few sprouts will appear next spring, but these may be neglected, as they will eventually be choked out. If a few stubs do not have transplanted buds growing on them, saw them off.

While pruning the trees during the third winter, cut back all branch stubs to the uppermost budded shoot, sloping the cut from the shoot downward to the opposite side. If the branch is larger than three inches in diameter, cover the cut surface with a suitable wound dressing.

TOPWORKING BY BUDDING TREES NOT PREVIOUSLY CUT BACK

Small trees may be topworked by placing the buds directly into the rough bark. Budding trees prior to cutting them back is best suited for well branched trees of two to six inches in trunk diameter. On such trees branches small enough for budding may be reached without difficulty.

The buds may be set at any time the bark slips on the branches. This is usually from the beginning of growth until June in seasons of average rainfall. The bark of the stock should be pared thin and the buds put in by the patch bud method. It will be necessary to use buds from large sticks, as smaller bud patches will not fit on the relatively large branches budded. On small trees, it is usually not necessary to bud every branch. Cut the strings about four weeks after budding, and do any necessary re-budding at this time, or at least before the end of the budding season.

If buds are set soon after growth starts in the spring, they may be forced immediately. For this purpose cold storage buds from one-year-old wood are desirable. If the buds are placed in the tree late in the season to remain dormant until the following spring, buds taken from large bud sticks are preferred.

During the winter following budding, cut all the budded branches back to about six inches beyond the transplanted bud, and cut back all other branches considerably in order to force the buds properly. After the branches are cut back to force the buds, the aftercare is the same as for trees with the tops cut back previous to budding, except that in most cases all seedling shoots may be removed the second winter unless the trees are large.

TOPWORKING LARGE TREES BY GRAFTING

Large pecan trees may be topworked by cutting back the branches and setting grafts on the stubs. The tree should be cut back at the time of grafting in the early spring. Leave a few uncut branches on the tree to carry on the plant processes; remove those branches the second or third year. If too much of the top is cut off after the tree is in full growth, the sudden checking of the sap flow, combined with the exposure of the trunk and branches to the sun, will likely result in sunscald.

Aftercare of grafted trees. It is generally a good practice to tie or cut back all rapidly growing grafts to insure them against breaking out during windstorms. The tips of the grafts may be pinched out when they are about twelve or eighteen inches long. This causes branching and thickening of the scions and a better union which prevents them from breaking out easily. Scions that are nailed to the stocks, as in the inlay bark graft method, seldom break out if they are judiciously pruned back during the first year.

During the first winter after the trees are grafted, cut back all seedling sprouts on the stubs to about three inches in length, except sprouts on stubs where the scions failed to grow and which may be budded in the spring. Seedling sprouts on the trunks of the trees should be cut back to about three or four inches in length. Correct any bad forks by pruning. Where two or more scions are growing on the same stub, all but the most desirable one should be cut back, but not removed.

During the second winter the trees are handled the same way as during the first winter. During the third winter, saw off all of the seedling growth flush with the bark of the parent branch and all unnecessary scions should be sawed off even with the new bark that is growing across the ends of the stubs. As a rule, the grafted top will be sufficiently developed by this time to choke out any seedling branches that start growth, and the top working is considered finished.

TOPWORKING TREES LESS THAN THREE INCHES IN DIAMETER

Trees with trunks less than three inches in diameter at a height of five feet require only one bud or scion each to form new tops of the desired variety. However, it is good practice to set two buds or grafts on each tree so that if one fails to grow, there will still be one to form the new top. If both buds or scions grow, the less desirable

one may be removed at the end of the first growing season, since two upright shoots on the same stub usually form a weak crotch.

Trees with trunk diameters less than 1½ inches are usually budded, but if the trunk diameters range from 1½ to three inches, bark grafting is probably more desirable than budding because the trees are easy to graft and the procedure of forcing is practically eliminated. The time for budding or grafting of small trees and the methods of forcing and aftercare of the buds or grafts are the same as for large trees.

Small trees accessible to livestock. The greater number of small seedling pecan trees to be topworked are on land that is pastured. Under such conditions the damage that may be done to the buds or grafts, or to the trees themselves by livestock is an important consideration. It is usually advisable to delay the topworking until the trees are large enough to be budded or grafted at a height of five feet from the ground. When the trees attain this size the buds or scions may be set and the lower branches left as barriers to livestock. Sometimes the top that is cut from a small tree is tied to the trunk lower down to keep livestock away from the buds or grafts.

If the trees are in clusters, the one nearest the center may be topworked and those on the outside left as protection. The branches next to the topworked trees may be cut back to prevent crowding. Livestock is more likely to be attracted by trees that are cut back than those left growing naturally and the surplus trees in the clusters can be removed after those that are topworked have grown out of reach of the livestock.

The branches of a small tree below the point of topworking should be retained temporarily, whether needed for protection from livestock or not. The shoot from the bud or scion alone is incapable of producing as many leaves the first year as the tree needs. The seedling branches may be cut back to one-half their length during the first winter after the trees are topworked. The next winter they should be sawed off flush with the trunk of the tree.

EQUIPMENT FOR PECAN PROPAGATORS

The pecan propagator should be equipped with the following articles: Budding apron, twine, rubber bands, pocket knife, grafting knife, parallel-blade budding knife, whetstone, pruning shears, one or two saws, saw file, waxed budding cloth, grafting wax, wax melter and brush.

Parallel-blade budding knives may be purchased from nurserymen or hardware stores. A less satisfactory knife may be made by fastening two safety razor blades in a block of wood. The blades should be about one inch apart.

A small curved saw with seven teeth per inch is easily carried and is suitable for making ordinary small cuts. A large curved saw with five teeth per inch is preferable for cutting back trees. Some propagators use straight saws manufactured especially for making the larger cuts. The saw teeth need setting occasionally and should be kept sharp at all times. Sawdust tends to adhere to the saw blade when sawing green pecan wood, eventually causing the saw to bind. This difficulty may be overcome by occasionally applying water to the saw blade with an oil can.

GRAFTING WAXES

There are numerous types of cover materials which are used successfully in budding and grafting. Soft wax applied with paddle or fingers formerly was extensively used. Today this type of bud or graft covering has been replaced largely by hot wax mixtures or waxed cloth. Waxed cloth is used as waxed patches or strips. The patches covering the bud area are tied in place with cotton twine (4- or 6-ply), or by rubber bands. If cloth strips are used, they should be made sufficiently sticky so that the bud may be held firmly in place by the cloth strip which must adhere to the surface of the bark.

Soft Grafting Wax No. 1

Rosin	4 pounds
Beeswax	2 pounds
Tallow or boiled linseed oil	1 pound

Melt the tallow, then add the beeswax, and finally the rosin. This wax is often used for the preparation of cloth for budding. A softer or harder wax may be made by varying the proportion of tallow or linseed oil in the formula.

Grafting Wax No. 2

Rosin	10 pounds
Beeswax	2 pounds
Filler	1 pound

Melt the rosin and beeswax together. Then stir in the filler, either kiesselghur (Celite No. 110) or talcum powder (purified talc). This wax is especially good for use in sealing inlay bark grafts, and

is applied in the melted stage at a temperature approximately that of boiling water (212°F.). Kiesselghur is preferable to talcum powder as a filler because it does not settle out when the wax is melted.

Paraffin makes a good melted wax for sealing buds, or grafts. It should not be applied at boiling temperatures but should be thoroughly liquified. Paraffin should not be used where it will be exposed to the hot summer sun, as it will melt and in this state will likely injure the cambium.

WAXED CLOTH

Waxed cloth for sealing buds is generally made by dipping strips of new or worn bed sheeting into melted wax. The wax must be hot but not boiling when the cloth is dipped into it. The surplus wax is drained from the cloth by drawing the cloth strip between two boards held over the wax container. Paraffin is used more than any other wax for preparing budding cloth, but some propagators do not like it for spring budding because it will not stick to the bark in cool weather. A sticky budding cloth may be prepared by using formula No. I.

THE WAX MELTER

Excellent factory-made wax melters are on the market and are to be recommended for those propagators doing considerable budding or grafting. However, the cost of these melters may be prohibitive for propagators who do only a little propagation. Therefore, the following directions are given for making a melter at home. Remove the top of an ordinary kerosene lantern. Select a narrow tin can that will fit into the opening and reach about half-way down to the wick. Insert the can into the top of the lantern and fasten with wire. A one-inch varnish brush is used for applying the melted wax. Drive a nail into the handle so that the brush may be hung in the cup with the bristles just off the bottom to prevent the bristles from getting overheated. If no suitable container is available for the wax cup, one can purchase this item from a tinner.

On days of high wind the flame of the lantern may blow out repeatedly. This trouble may be overcome by setting the lantern into a heavy paper bag and tying the bag around the lantern near the top. Make a few small holes in the bag near the bottom to allow the entrance of air.

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